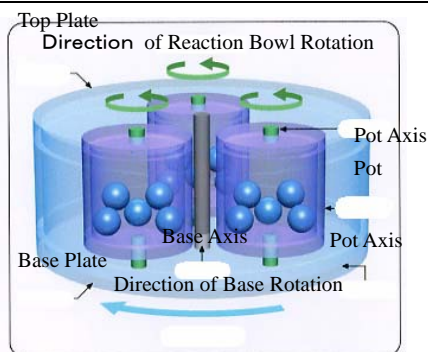
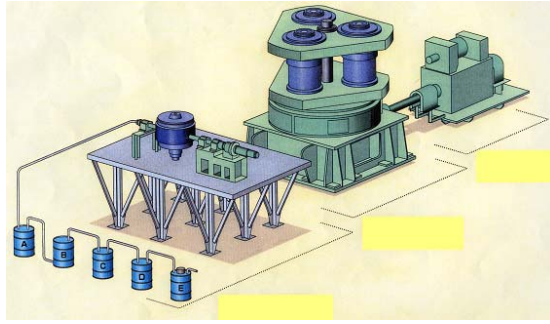


Radicalplanet Technology
(Mechanochemical Principle)

<p>Name of Process: Radicalplanet Technology</p> <p>Vendor: Radicalplanet Research Institute co. Ltd. Web site: http://www.radicalplanet.co.jp</p> <p>Applicable Pesticides and related POPs wastes:</p> <p>1. Materials:</p> <p>(1) PCP, Chlordane, BHC, DDT, Endrin, PCB, DXNs (2) Mixture of Pesticides and related POPs wastes (3) Admixture (Soil, stones, concrete, glass, metal, plastics) polluted by PCB oils and POPs wastes. (4) Fly ash and Incineration ash polluted by DXNs.</p> <p>2. Form and conditions:</p> <p>(1) Solid and Powder (2) Liquid and Emulsion (3) Contaminated Materials (Fluorescent Stabilizer, Paper)</p>	<p>Status:</p> <p>1. Pilot Commercial Equipment Operation (200kg/charge) (1)1999-:Detoxification of Soil and Ash contaminated by DXNs. (2)2000-:Detoxification of Pesticides and POPs wastes. (3)2001-:Decomposition and detoxification PCB in liquid, contaminated soil and stabilizers</p> <p>2. Commercial Equipment Operation The commercial system of Radicalplanet is planned to operate in May, 2005, and full scale one is February, 2006.</p> <p>3. Authorization by Government. The permission to apply the “Radicalplanet Technology” was officially granted by the Notification No.25 (April 1, 2004) of the Environment Ministry in the name of the “kikai kagaku bunkai hoho” (mechano-chemical decomposition method) under the law for special Measures in relation with the law for PCB (and POPs) waste disposal.</p>
<p>Technology description:</p> <p>The aim of “Radicalplanet Technology” is to prove the complete detoxification technology that changes the harmful compounds (ex. Chlorinated organic compounds), into safety compounds under non-heating, atmospheric conditions and closed system by the mechanochemical principle. While the Pesticides, PCB, and related POPs wastes are treated there are no exhaust gas and effluents at all. There is no fear of secondary pollution that is caused by transportation of the harmful compounds, because the system is a movable type and is able to treat the pollutant on site. In addition, this process is guaranteed clean conditions because the reaction is caused with mechanical energy without producing combustion gas. In concrete, steel balls crush hard each other under non-heating condition. The bond of each molecule is, therefore, cut by mechanical energy. The molecules are decomposed into the state of activation, called the radical state, so that chemical reaction is accelerated.</p> <p>In case of chlorinated organic compounds, when a physical energy greater than a specific strength is exerted, the compounds containing chlorine will be chemically activated (chlorine and carbon bonding is weaker and leached, and chlorine becomes separated). The dechlorination reaction takes place without heating the harmful compounds. The additives such as CaO may be added depending on the desired end products (commercial products). In any cases, safe and less expensive additives are selected for specific purposes. The chlorines in radical state combine with CaO put into the reactor, and produce chlorinated inorganic compounds, CaCl₂, Ca(OH)Cl, that are stable compounds. The organic compounds are condensed together, condensation reaction, are formed a carbon dual bond and so on [1, 2].</p> <p>“Radicalplanet Technology” process means that the technical method can decompose the molecules into “Radical” state by use of the “Planetary mill” and simultaneously change the harmful compounds into entirely substances of different molecular structures (target substances) by causing chemical reaction with introduced non-harmful substances in the closed system without heating the materials.</p>	
<p>Characteristics of the Radicalplanet Technology</p> <ul style="list-style-type: none"> • No heating is required for the reaction to take place. The system involves safe reactions with minimum side reactions. • No exhaust gas and no effluents such as harmful organic compounds will be generated. The energy consumed is minimized (no heating being required). The system is simple and operated at low cost. • Cleaning and disposal process may be done on site. The process is highly safe since no transfer of the polluted substances will be needed. The system contributes to environmental preservation and minimized the anxiety of the local communities. The equipment is movable and compact. It is highly cost effective. • The system is resource saving and highly effective. Safe detoxifying agents, including CaO, SiO₂, Al₂O₃ (substances contained in soil), are used. The contaminated soil may be recycled after the detoxification. • At the state of emergency the system can be shut down completely. At the earthquake and the natural phenomena, the system can be stopped safely, immediately and completely. After that the system can be continued to operate again safely. 	
<p>Process diagram:</p> <p>1. Put the harmful compounds (PCB, Pesticides and related POPs wastes) with glass bottle, bag, can, plastic and the other container into the reactor pots(bowls) of the equipment(the Planet E-200 type). The additives such as CaO may be added with SiO₂, Al₂O₃. depending on the desired end products. The capacity of the pot is 800 liters, the equipment has three pots.</p>	



- After closing the reactor pots, the rotation of the reactor pots is started.
The direction of reactor pots rotation is contrary to the direction of base rotation.
The each rotation speed is 70-100 rpm.
The chlorine in organic compounds are decomposed and changed to the inorganic compounds.
During the dechlorination reaction, exhausted gas and effluents never generated.
[The dechlorination reaction is finished at 3-6 hours at the condition of 100rpm, rotation speed.]
- Take the fine CaO based powder after the dechlorination reaction out of the pots by air (gas).
Neither the powder nor the exhausted gas has chlorinated organic compounds.



Radicalplanet System



Planet E-200 type

Performance:

Treatment efficiency:

Vendor	Radicalplanet Research Institute co. Ltd.(former Sumitomometals co.,Ltd.)								
Name of Process	Radicalplanet Technology								
POPs wastes	name	PCP	chlordan	BHC	chlordan	BHC	DDT	Endrin	
	figure or state	liquid	emulsion	liquid	emulsion	admixture of powder (underground)			
	Input Weight(kg)	0.7	0.7	0.7	3.5	3.5	2.5	2.5	2
	DXNs(pg-TEQ/g)	1,600,000	990	26	26	190			
Agency for dechlorination: CaO		57.6	69.3	55.2	57.6	55.3	63		
The other added agency: SiO ₂		11.7	0	11.3	11.7	11.2	0		
Exhaust gas	non								
Effluents	non								
Powder	Weight(kg)	70.1	71.2	68.1	73.9	71.2	71.5		
	DEs(%)	> 99.997949	> 99.997530	>99.999490	>99.999891	>99.999521	> 99.998903	> 99.999342	> 99.997943
	DREs(%)	> 99.9999998	> 99.99999628	>99.9999981	>99.9999996	>99.9999954	> 99.9999983	> 99.99999898	> 99.99999681
	DXNs(pg-TEQ/g)	0.18	0.034	0.14	0.031	6.2	0.12		
cooling water for machine(L)	15,000								
	DXNs(pg-TEQ/g)	0.016		0.024		0.056	0.056		
powder collection gas (m ³)		0.85	0.92	0.88	0.88	0.92	0.85		
	DXNs(pg-TEQ/g)	0.52	0.5	0.0023		0.00011	0.0024		

- Final product is the fine powder particles .
- There are no noise pollution and no tremor of the earth.
- The operation was progressed quite satisfactorily on these treatments.
- Final product contains the iron powder, because the steel pots is worn out.

Throughput:

- The Pesticides and related POPs wastes:
 - 1 equipment (Planet E-200 type = 200kg/charge) :60-80 kg/day [20kg/charge]
 - 1 system for commercially (3 equipments of Planet E-200 type) : 200 kg/day
- Soil and the other admixture:
 - 1 equipment (Planet E-200 type = 200kg/charge) : 240-320kg/day [80kg/charge]
 - 1 system for commercially (3 equipments of Planet E-200 type) : 800 kg/day

These capacity change, because the ratio (CaO / harmful compounds) is altered for each material.
The operation period is almost 24 hours per day, and in the case of "Radicalplanet System" operation period is able to select 8 or 16 hours.

Wastes/Residuals:

1. During the dechlorination treatment:
There are no exhaust gas, no effluents and no the other medium.
The cooling water for machine is circulated in the system. [This water is never contaminated by the harmful materials.]
The gas inside the pots is absorbed by the activated powder at the end of treatment.
2. After the dechlorination treatment:
There are fine powder particles in the reactor pots in the equipment.
The powder is completely safety, and its size is under 0.1 μ.
The air (gas) is used for take the powder out of the pots, and the fine dust in the gas is collected by filter, water and activated carbon.

Reliability:

1. Soil contaminated by DXNs
1999 Certified by Ministry of Environment
Selected as "The 100 Environmental Technologies for Preserving Earth " edited by Environmental Ministry
2. Decomposition & Detoxification of Pesticides and related POPs wastes
2000 Certified by MAFF (PCP, Chlordane)
2001 Certified by MAFF (BHC, DDT, Endrin and underground Pesticides, Admixture of these powder and emulsion)
2003 Certified by MAFF (PCNB)
3. Decompose and detoxify PCB in liquid, contaminated soil and stabilizers
2001 Certified by Ministry of Environment
2002 Certified by Ministry of Economics & Industry (former Ministry of International Trade and Industry)
2003 Certified by Ministry of Environment (former Ministry of Public Welfare & Labor)

The permission to apply the "Radicalplanet Technology" to PCB waste disposal was officially granted by Notification No. 25 (April 1, 2004) of the Environment Ministry in the name of the "kikai kagaku bunnkai houhou" (mechanochemical decomposition method) under the law for special Measures in relation with the law for PCB waste disposal.

Limitations:

- Form and Condition of the Materials
[Radicalplanet system can be applicable to any Solid]
1. PCB, Pesticides and related POPs wastes powder or other substances containing the powder (including fluorescent stabilizer, electric cable)
 2. Metals, soil, stone, sand, concrete, glass, paper, cloth, woods, plants and plastics contaminated by PCB, pesticides and related POPs wastes.
- [Radicalplanet system can be applicable to Liquid and Emulsion]
1. Oils (PCB, PCP, BHC and liquid agricultural chemicals)
 2. Emulsion (Agricultural chemical for air spraying and organic solvent) and solid materials contaminated by emulsion or admixture (including agricultural chemicals mixed with glass, soil contaminated by pesticides or herbicide, protective apparatus and working clothes) .

Transportability:

"Radicalplanet process" is constituted by three equipments, the Planet E-200, a motor and powder collecting equipment.
These equipments are simple, compact and are transportable by trailers. The main equipment, Planet E-200, is also separated two pieces for transport.[photo]



The other type of main equipment:

Scale: "Planet-200 type" means that the total capacity (800 liters) of three pots is 200 kg/charge.
And the others are Planet-50 type, Planet-20 type and Planet-2 type

Aim : "E-type" means multipurpose type (Earth)
And the others are for PCB and POPs treatment, for PVC (Poly-vinyl-chloride), for Ash and soil contaminated by DXNs and PCB, for Asbestos and for deregistration of data from IT memories.

Detailed information:

Conclusion:

Characteristics of "Radicalplanet Technology"
(1) A specific goal for the decomposition system can be set.
The materials to be processed can be decomposed 100%, or whatever figure desirable for the customers including the environmental standard set by the administration. A quotation will be prepared taking various factors into account and may differ depending on the

condition of the pollution or pollutants (pure or combined).
(2)The pollutants (materials) can be processed on site.
There will be no secondary pollution to the surroundings since exhaust gas and effluents will not be generated by processing. It is a safe closed processing system which is movable and can be relocated.
(3)The system can be adjusted to allow an efficient processing for a requested quantity within a specified time frame. There is no need to keep the system at a high temperature at any time. The system can be stopped and started as requiring no idling of motor. The system can be adjusted to complete the work within a specific time frame. (Number of equipment or machines can be coordinated.)
(4)The end products resulted from the processing can be used for various purposes of the customer's choice ; the disposal is not required. The processing of the materials will result in non-harmful substances which will be divided into two groups: organic compounds and inorganic compounds. The inorganic compounds, which are low in alkaline leaching, can be used as soil of any particle sizes or as a substitute for concrete having a high durability and ability to accommodate vegetation. Organic compounds can be used to make polyethylene materials and diesel fuel or lighting source.

Full Scale Treatment examples:

1. Pilot Commercial equipment "Planet E-200 type" is already operated since in 1999.
By using of this equipment the permission to apply the "Radicalplanet Technology" was officially granted.
And the renewal equipment is planned to operate in May, 2005.
2. Full scale treatment is planned to operate in February, 2006, by use of three "Planet E-200 type" equipments.

Vendor Contact details:

Radicalplanet Research Institute Co. Ltd.

Head Office: 1-25-8 Matsuyama, Naha City, Okinawa Prefecture, JAPAN.

Phone: +81-98-864-1180 Fax : +81-98-878-6642

e-mail: info@radicalplanet.co.jp

Nagoya Office: mezon-west 1-5 , 3-39 Toyomae-cho, Higashi-ku, Nagoya, Aichi Prefecture, JAPAN.

Phone: +81-52-930-5655 Fax : +81-52-930-5633

Patents:

- (1)Technology : 14 items.
- (2)Machine : 6 items

References:

1. "Technology of Resource Processing," Vol.18 (2001), 238-243
2. Lecture Script: Japan Society of Powder and Powder Metallurgy Spring Meeting, "the society of chemical Engineering, Japan," Vol.66 (2002) No.11, pp714-715.
- 3.Editor of "100 Environmental Technologies for Preserving Earth " by Association for the Prevention of Pollution, Environmental Agency,(2000), pp.120-121.
- 4."Ceramics," Vol.37 (2001), No.12, pp.936-940.
- 5."Metals," Vol.72 (2002), No.11
- 6."Detoxicating Dioxines in soil by mechanochemical method", World congress on particle technology 4, july (2002), Sydney Australia.
7. <http://www.radicalplanet.co.jp>